Response Distance between Smartphones & TimeTec BLE 2 For Smart Door

1.0 Objective

This test is to determine the maximum distance in relation to the various brands of smartphone when connecting and triggering the TimeTec BLE-2 to unlock doors.

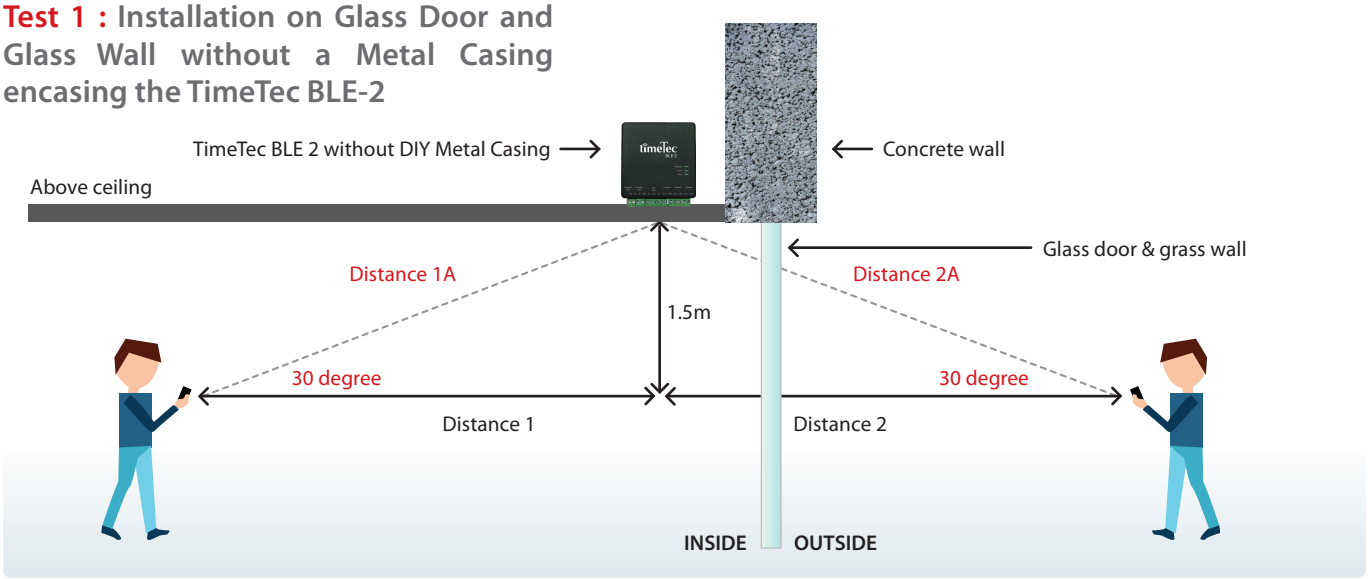
2.0 Test Site

Two factors have been found to affect the response distance between the smartphones and TimeTec BLE-2:

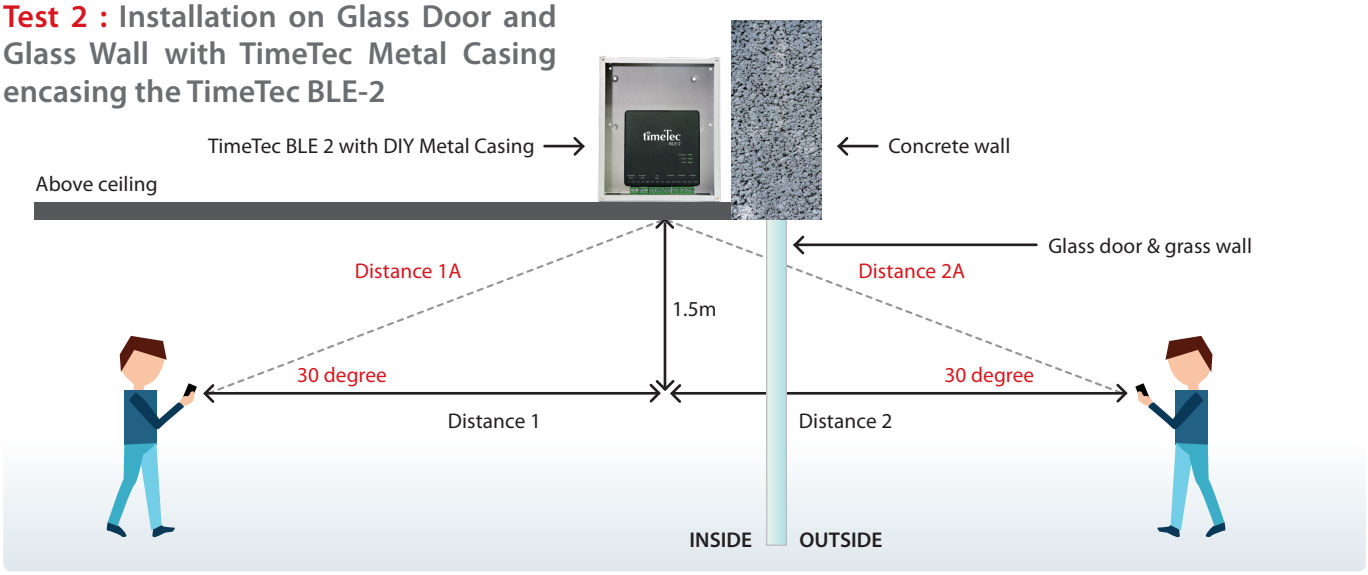
- The Bluetooth potential interference (Appendix 1 & 2)
- The brand and the model of the smartphone

The tests were done at a main entrance with a glass door and on a glass wall. During the testing period, the indoor temperature was approximately 18°C while the outdoor temperature was 34°C.

Test 1 : Installation on Glass Door and Glass Wall without a Metal Casing encasing the TimeTec BLE-2



Test 2 : Installation on Glass Door and Glass Wall with TimeTec Metal Casing encasing the TimeTec BLE-2



3.0 Test Installation

The TimeTec BLE 2 was installed with its switching power supply and battery above the ceiling,near the door to achieve optimization of broadcast range for inside and outside the building.

NOTE: If the installation is made far away from the door, the person from the outside might need to get closer to the door to receive the TimeTec BLE-2 signal; but in contrast, the App of a person inside the building could be detected by the TimeTec BLE-2 from a farther distance. Unless necessary, it is best to avoid imbalance of distance between the outside and the inside because it could inconvenience the users.

Two tests were carried out at the same Test Site.

Test 1: Installation on Glass Door and Glass Wall without a Metal Casing encasing the TimeTec BLE-2
Test 2: Installation on Glass Door and Glass Wall with TimeTec Metal Casing encasing the TimeTec BLE-2

TimeTec DIY Metal Casing is often used to house and protect TimeTec BLE-2 and its accessories such as switching power supply and battery. This serves as an advantage because of metal having the highest **Interference Potential** (Appendix 1) to the **Bluetooth Signal** (Appendix 2). Hence, by using a metal casing, the response distance is shortened and thus requires users to be closer to the door in order to access it. This is particularly useful for security concerns because it would be risky if users can unlock the doors from afar and exposing the space to potential outside threats.

The installation of the TimeTec BLE 2 and its accessories with metal casing dan be done on the wall or above the ceiling. Our test unit was placed above the ceiling.

4.0 Test Result

Test 1: Installation on Glass Door and Glass Wall without a Metal Casing encasing the TimeTec BLE-2

Smartphone brands and models	Max response distance(Meter)			
	Distance 1	Distance 1A	Distance 2	Distance 2A
iPhone 6	20	23.1	14	16.2
iPhone 7	20	23.1	14	16.2
iPhone SE	20	23.1	7	8.1
Google Pixel	36	41.6	30	34.6
Google Pixel 2	30	34.6	24	27.7
Samsung Galaxy S8/S8+	14	16.2	22	25.4
Huawei P9 Plus	20	23.1	14	16.2
Huawei P9 Lite	20	23.1	14	16.2
Oppo F1	18	20.8	12	13.9
Xiaomi Note 4	20	23.1	14	16.2

Test 2 : Installation on Glass Door and Glass Wall with TimeTec Metal Casing encasing the TimeTec BLE-2

Smartphone brands and models	Max response distance(Meter)			
	Distance 1	Distance 1A	Distance 2	Distance 2A
iPhone 6	10	11.5	7	8.1
iPhone 7	10	11.5	7	8.1
iPhone SE	10	11.5	3	3.6
Google Pixel	18	20.8	15	17.3
Google Pixel 2	15	17.3	12	13.8
Samsung Galaxy S8/S8+	14	16.2	11	12.7
Huawei P9 Plus	10	11.5	7	8.1
Huawei P9 Lite	10	11.5	7	8.1
Oppo F1	9	10.4	6	6.9
Xiaomi Note 4	10	11.5	7	8.1

The tests were repeat using 3 types of unlocking methods in i-TimeTec App:

- Tap Button on App
- Voice Command
- Auto Unlock Command Within An Effective Range.

5.0 Conclusion

The response distance varies with smartphone brands and models due to the differences in hardware and OS used. The shortest response distance was recorded by an iPhone SE at 3.6 meters under Test 2. This is still a reasonable distance for users accessing the doors via i-TimeTec App. The farthest response distance ever recorded is by using Google Pixel at 36 meters under Test 1. However, the far response distance does not serve any useful purpose for the users as he/she will still be required to arrive at the door in order to access it. The installation of TimeTec BLE-2 with metal casing has thus reduced its response distance to almost 50%.

Appendix 1: Bluetooth Communication Mechanism

The TimeTec BLE-2 smart door controller is a Bluetooth 4.2 enable device that broadcasts its unique ID via Bluetooth signal to be detected by smartphones installed with i-TimeTec App. Most of the smartphones can respond to the Bluetooth 4.2 and some new models even can support Bluetooth 5. The below table is the comparison between different Bluetooth versions:

	BLUETOOTH V2.1	BLUETOOTH 4.0 (LE)	BLUETOOTH 5.0 (LE)
Range	Up to 100 m	Up to 100 m	Up to 400 m
Max range (free field)	Around 100 m (class 2 outdoors)	Around 100 m (outdoors)	Around 1,000 m (outdoors)
Frequency	2.402 – 2.481 GHz	2.402 – 2.481 GHz	2.402 – 2.481 GHz
Max data rate	1- 3 Mbit/s	1 Mbit/s	2 Mbit/s
Application Troughput	0.7-2.1 Mbit/s	Up to 305 kbit/s	Up to 1,360 kbit/s
Topologies	Point-to-point, scatternet	Point-to-point, mesh network	Point-to-point, mesh network
Network Standard	IEEE 802.15.1	IEEE 802.15.1	IEEE 802.15.1

Appendix 2: Interference Potential

However the Bluetooth broadcast range is affected by the surrounding especially building material (Refer to the table below). Bluetooth is transmitting data via radio frequency. Radio frequency can be absorbed or reflected by barrier. Refer to the table below, we can see the type of barrier and its interference potential. The low interference potential indicates the material has less impact to the Bluetooth transmit distance. As metal has the highest interference potential to radio frequency, we foresee the max response distance test with metal casing shall be shorter than the test without metal casing.

TYPE OF BARRIER	INTERFERENCE POTENTIAL
Wood	Low
Synthetic material	Low
Glass	Low
Water	Medium
Bricks	Medium
Marble	Medium
Plaster	High
Concrete	High
Bulletproof glass	High
Metal	Very high